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GB 1515611
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(54) Pirani vacuum gauge

(57) In a controlled heat conducting Pirani vacuum gauge comprising a measuring wire arranged in a bridge circuit (6), the bridge supply current, flowing as a result of the regulated supply current, is used as a measure for indicating pressure. The supply voltage applied to the bridge is so regulated that the resistance and hence the temperature of the measuring wire remain constant. The bridge control amplifier may be associated with the indicator 10 or with the bridge circuit. The supply current or a voltage derived therefrom may be measured.

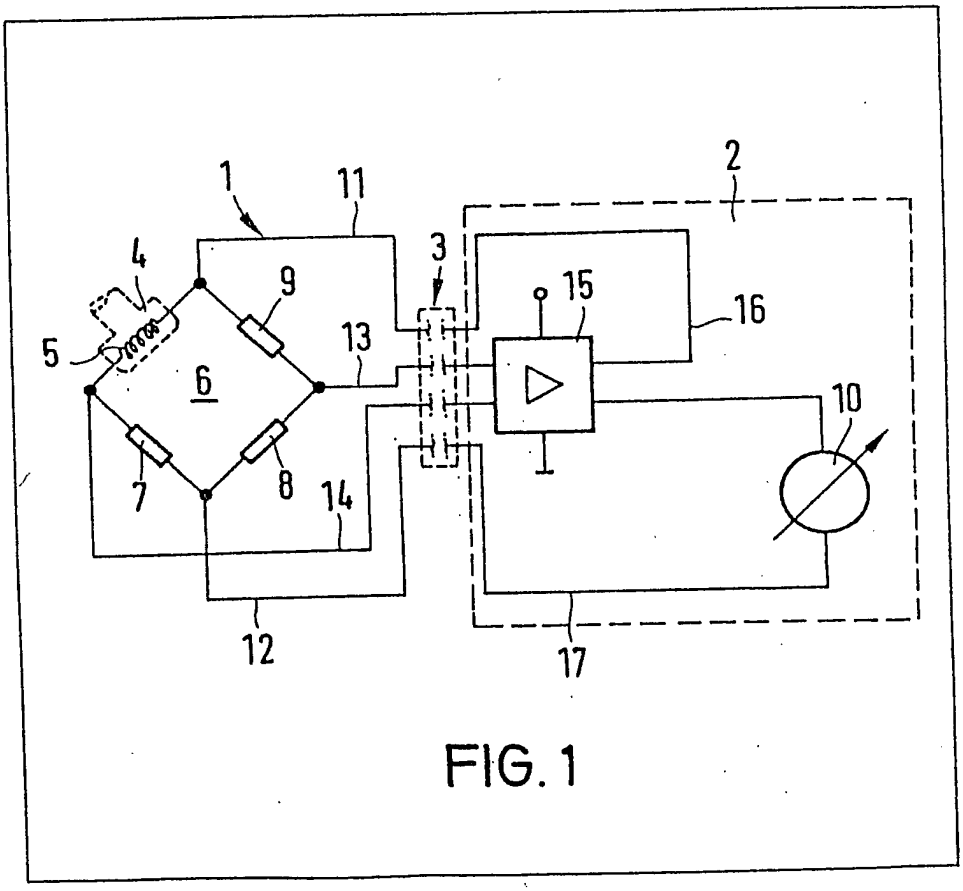

FIG. 1

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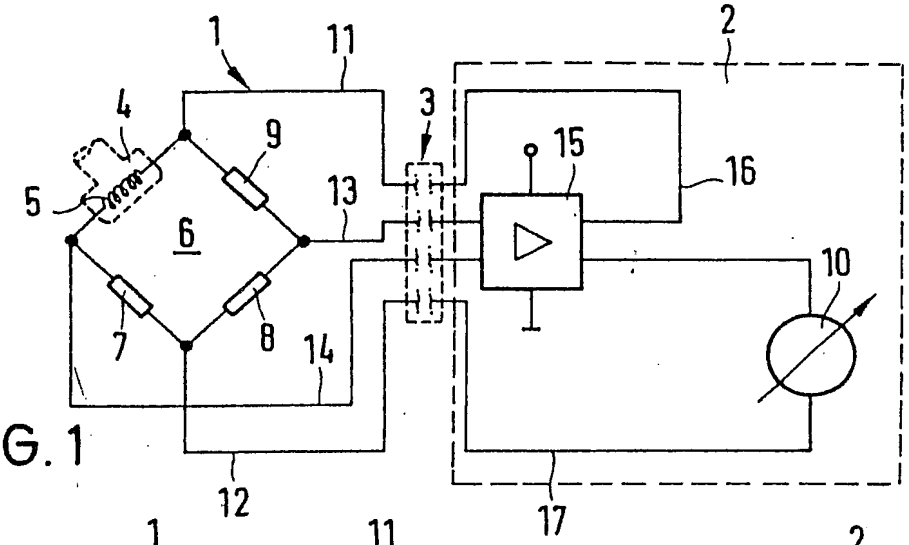

FIG. 1

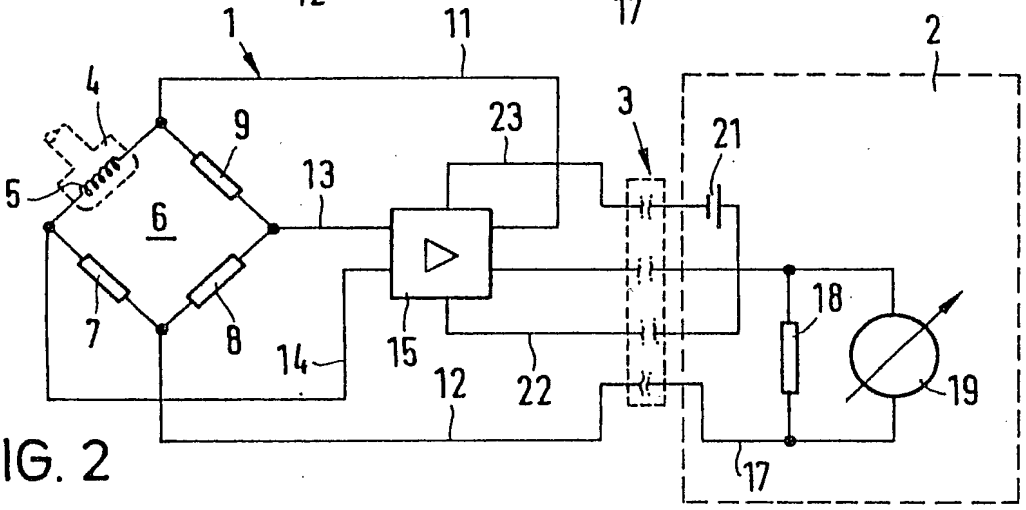

FIG. 2

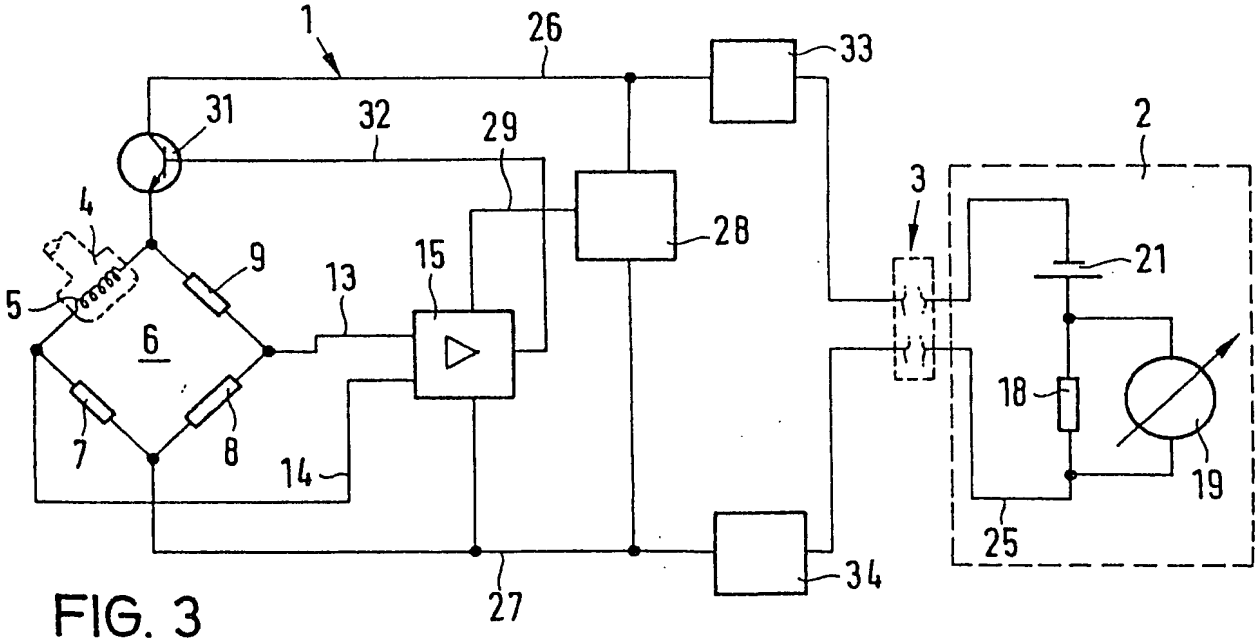

FIG. 3

SPECIFICATION

Method of operating a controlled Pirani vacuum gauge and a Pirani vacuum gauge suitable therefor

The invention relates to a method of operating a heat-conducting Pirani vacuum gauge. The invention is also concerned with a Pirani vacuum gauge suitably designed for performing this operating method.

In what are called controlled heat-conducting Pirani vacuum gauges, a measuring wire is connected into a Wheatstone bridge. The supply voltage applied to this bridge is so regulated that the resistance and therefore the temperature of the measuring wire remain constant irrespective of the emission of heat. This regulation has a time constant of a few milliseconds, so that the equipment reacts very rapidly to changes in pressure. Since the transmission of heat from the measuring wire to the gas increases with pressure, the voltage occurring at the bridge is a measure of the pressure. Apart from the short setting time, regulated heat-conducting Pirani vacuum gauges have the advantage of a relatively wide measuring range. Because of these advantages, heat-conducting vacuum gauges of this kind are preferred for controlling pressure or for pressure-monitoring functions. For this purpose it is often necessary to provide, between the pressure take-up means (the measuring bridge plus the measuring tube) and the supply means comprising, among other things, the amplifier for producing the regulated bridge voltage, relatively lengthy measuring cables which may be of different kinds depending upon local conditions.

There thus occurs the danger of undesirable falsification of the pressure indication, since this can be correctly reproduced only if the line resistance is low compared with the total resistance of the measuring bridge.

This disadvantage is well known, and efforts have already been made to eliminate it by means of an arrangement comprising two additional lines for the high-resistive measuring of the voltage applied directly to the measuring system. This, however, of necessity, adds to the cost. In addition, such an arrangement is trouble-prone. A further possible step is to equalize the lengths of the cables with the aid of a voltage divider located upstream of the indicating instrument. A disadvantage of this system is that equalization can be achieved only after the measuring apparatus is brought into operation by using a particular cable, and this requires the presence of qualified technical personnel for each local variation.

The object of the present invention is to provide a method for operating a controlled heat-conducting Pirani vacuum gauge and a vacuum gauge which is suitable for performing this method of operation and in which the measured quantity is independent upon line and contact resistance.

According to the invention, this object is achieved in that the bridge-supply current, flowing as a result of the controlled supply voltage, is used as a measure for the pressure indication. A measured amount of this kind is independent of line and contact resistances. Furthermore, this proposed solution does not suffer from the disadvantages of the above-mentioned known proposal for eliminating errors in the indication of pressure.

A further expedient step is that the power supply for a pressure take-up means, comprising at least the measuring tube, the components of the Wheatstone bridge and the components of an amplifier, is likewise achieved through the bridge-supply circuit. Thus, it is possible to dispense with a cable containing four separate conductors between the pressure take-up means and a supply and indicating appliance. This cable, which is often very long in cases where pressure is to be monitored or controlled, then requires only two conductors.

A Pirani vacuum gauge suitable for performing the operating method in accordance with the invention is characterized in that an ammeter or a resistor is connected into that part of the circuit supplying the measuring bridge that lies in the zone of the supply and indicating appliance, with which ammeter or resistor is associated a means for indicating the voltage drop across the resistor.

Further advantages and details of the invention will now be described by reference to examples illustrated in Figures 1 to 3. Each of the Figures — all in very diagrammatic form — shows the pressure take-up means 1 on the left and the supply and indicating appliance 2 (in broken lines) on the right. The two parts are interconnected by a cable 3, the length of which differs according to the application.

In the Figure 1 arrangement, the pressure take-up means 1 comprises the measuring tube 4, the cavity of which is connected to a container, not illustrated, in which the pressure, for example, is to be controlled or monitored.

Located within the measuring tube 4 is a measuring wire 5 which is connected into the Wheatstone measuring bridge 6 by means of the further resistors 7, 8 and 9. The conductor sections 11 and 12 located in the pressure take-up means 1 are components of the bridge supply circuit. The conductor portions 13 and 14 serve to transmit fluctuations in the bridge voltage to the amplifier 15.

In the Figure 1 arrangement, the amplifier 15 (control amplifier) is a component of the supply and indicating appliance 2. The connecting cable 3 therefore has four wires. The conductor portions 16 and 17 form that part of the bridge supply circuit contained in the supply and indicating appliance. An ammeter 10 is connected into the conductor portion 17. When changes in pressure occur within the measuring tube 4, the current flowing in the bridge supply circuit changes, this current being indicated by the ammeter 10 and constituting a direct measure of the pressure

obtained therein.

The Figure 2 arrangement differs from that shown in Figure 1 firstly in that the amplifier 15 is a component of the pressure take-up means 1. Thus, although it is no longer necessary to extract the bridge voltage fluctuations from the pressure take-up means, the cable 3 again has four wires since the voltage supply for the amplifier 15 (voltage source 21) lies in the supply and indicating appliance. The voltage source 21 is connected to the amplifier 15 through the cable 3 and the conductor portions 22 and 23. A further difference between the Figure 2 arrangement and that shown in Figure 1, consists in the fact that the ammeter 10 is replaced by the resistor 18 and the voltage-measuring means 19 which bridges the resistor 18. The voltage-measuring means 19 indicates the voltage drop across the resistor 18. This indication likewise corresponds to the current flowing in the conductor portion 17 and can therefore be used as the pressure-measuring value.

In the arrangement shown in Figure 3, the amplifier 15 is likewise part of the pressure take-up means 1. To permit the use of a connecting cable 3 having only two wires, at least parts of the bridge supply circuit and the general supply circuit are identical.

In the arrangement shown in Figure 3, the supply and indicating appliance 2 contains a circuit part 25 into which are connected the resistor 18 and the supply-voltage source 21. This circuit is extended in the pressure take-up means 21 by the conductor portions 26 and 27. These are bridged by a voltage stabilizer 28, the output of which is passed, by way of the conductor portion 29, to the amplifier 15 and supplies it with constant voltage.

Also illustrated in the Figure 3 arrangement is a transistor 31 which is contained in the bridge supply circuit and the base of which is connected to the output of the amplifier 15 through the conductor 32. The transistor 31 forms the variable resistor in the bridge supply circuit whereby constant balancing of the Wheatstone bridge 6 is achieved. The current fluctuations which occur in the bridge supply circuit formed by the conductor portions 25, 26 and 27, and which result from differing pressures within the measuring tube 4, agsin cause differing drops in voltage through the resistor 18, so that the pressure that is of interest can be read off at the indicating appliance 19. The indicating appliance 19 may, of course, be replaced by other electronic means which enable any required control or regulating operations to be carried out.

In addition, protective barriers 33 and 34, which likewise form components of the pressure take-up means 1, can be connected into the bridge supply circuit shown in the example illustrated in Figure 3. The purpose of these protective elements is to render the operation of the pressure take-up means safe from explosion. The protective elements may be formed, for example, by Zener diodes, which have the property of imposing a top limit on power fluctuations that could possibly lead to sparking. It is also possible to arrange these protective elements 33 and 34 in that part of the bridge supply circuit that is located outside the pressure take-up means, i.e. in the operating appliance 2, for example.

CLAIMS

1. A method of operating a heat-conducting Pirani vacuum gauge comprising a gauge wire arranged in a bridge circuit and a means for regulating the bridge-supply voltage such that the resistance and therefore the temperature of the gauge wire is constant irrespective of the heat emission (controlled Pirani), characterized in that the bridge-supply current, flowing as a result of the controlled supply voltage, is used as a measure for the pressure indication.

2. A method according to claim 1, characterized in that the power supply of a pressure take-up means comprising at least the gauge tube, the components of the Wheatstone bridge and those of an amplifier, is likewise achieved through the bridge-supply circuit.

3. A Pirani vacuum gauge suitable for performing the operating method of claim 1 or claim 2 and having a pressure take-up means and a supply and indicating appliance, characterized in that a resistor is connected into a part of the bridge circuit that lies within the supply and indicating appliance, with which resistor is associated an instrument for indicating the voltage drop across the resistor.

4. A vacuum gauge according to claim 3, characterized in that the pressure take-up means comprises, in the known manner, the components of the Wheatstone bridge including the measuring tube, as well as the componetns of an amplifier.

5. A vacuum gauge according to claim 4 and suitable for performing the operating method of claim 2, characterized in that the pressure take-up means comprises electronic means for maintaining the supply voltage for the amplifier at a constant level.

6. A vacuum gauge according to claim 4 or claim 5, characterized in that the output of the amplifier is connected to the base of a transistor contained in the bridge-supply circuit.

7. A vacuum gauge according to any one of claims 3 to 6, characterized in that protective barriers are connected into the bridge-supply circuit.

8. A method of operating a heat-conducting Pirani vacuum gauge as claimed in claim 1 or claim 2 and substantially as hereinbefore described.

9. A Pirani vacuum gauge constructed, arranged and adapted to operate substantially as hereinbefore described with reference to Figure 1, Figure 2 or Figure 3.

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